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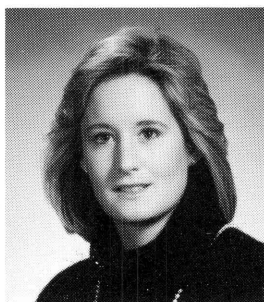
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HUMAN RESOURCE ISSUES IN THE TRANSFORMATION TO THE FACTORY OF THE FUTURE

Michelle Miller



I. Dimensions of the Factory of the Future

Over the past decade, U.S. industry has developed the potential to transform many manufacturing facilities into "factories of the future." By the factory of the future is meant one which uses the constellation of "highly mechanized, automatic, hands-off, low-labor-content, self-correcting, self-controlling EPTs (equipment and process technologies)" (Skinner, p. 104). Programmable automation, the computerization of machines to perform certain tasks, is an important element of this factory (Blumenthal & Dray, p. 31).

The purpose of this paper is to provide a brief overview of the state of the factory of the future today. I will then discuss how labor—the "human resource factor"—is likely to be affected by the factory of the future and then offer several means which firms can use to ease the transformation.

There are both opponents and advocates of the widespread introduction of robotics and other forms of automation into the workplace. Opponents often argue that too many workers

will be replaced by machines and will become unemployed. Those in favor of rapid technological implementation contend that unless factories undergo such changes, U.S. industries will become less competitive, a situation which will lead eventually to even more job losses (Williams, p. 26). It is not the purpose of this paper to decide which side is correct but simply to present the issues which have been raised.

A. Promises of the Factory of the Future

Many organizations strive to introduce new technology into the workplace because of the many benefits which automation promises. In addition to increasing the manufacturing plant's productive capacity, automation can reduce the volume of scrap, shorten lead time, increase utilization of equipment, lessen set-up time, and reduce both floor space and work-in-process inventory (Bright, p. 80). One example of this new technology is the introduction of robots whose main function is to "replace, augment, aid, and improve human performance in

sensory, manipulative, and cognitive functions" (Lyman & Madni, p. 39). From the worker's point of view, the implementation of such technology requires less manual labor and improves safety and working conditions, while it makes both plant administration and production control jobs easier (Bright, p. 80). When one considers all of the advantages of automation, one sees an overall lessening of costs, improvement in operations, and enhancement of the work environment (Bright, p. 83).

From a national perspective, the promise of the factory of the future is to enable U.S. factories to compete more effectively with international manufacturers in providing high quality products at competitive prices. If this does not occur, American manufacturers may become overpowered by foreign competitors producing better goods at lower cost to the consumer. However, the United States has notably lagged behind its competitors with respect to one particularly important type of new technology: the adoption and implementation of industrial robots in the workplace.

Industrial robots are not a new phenomenon, for they have been present in the U.S. work environment for the past two decades. However, there have been three distinct stages in the capabilities and progress of these machines. In the 1960s, the first generation of robots was involved simply in the basic transfer of materials. The robots of the 1970s advanced to higher levels of duties, such as welding car bodies and operating other machines. The 1980s brought a third generation of robots, which can not only perform such tasks as arc welding, but which can also manipulate and inspect production items by tactile means (Soska, p. 14). Yet, today's highly advanced robot workforce still lacks several desirable skills possessed by humans. These machines cannot deal with unplanned events nor can they "learn" from past experience (Ayres & Miller, "Robotic Realities," p. 29). This may be one reason why wary firms have not yet decided to adopt robotic technology. However, some experts predict that in the near future, we can expect the development of yet another generation of robots—this one with sensory capabilities and, perhaps, even powers

of thought. The robot potential seems to be unlimited.

It might be interesting to speculate briefly about what it might be like to work in the "factory of the future." Let us assume it is the year 2000, and we are engineers on our way to work. As we enter the factory, we can still remember when all the many transformation processes began. The company certainly encountered its share of problems: unexpected downtime, debugging problems, and worker relations difficulties. However, after several years, all of these problem areas were addressed as the company progressed toward increased productivity, an improved product, and a greater ability to compete with foreign firms. Now, factory life is somewhat different than in the past. There are fewer operators but more programmers and more maintenance workers. Yet, only those who were willing and able to make the transformation are still with the company. Those who could not or would not adapt to the necessary retraining had to take lower positions or look elsewhere for employment.

As we make our way to our work areas, we suddenly realize the sterility and efficiency which is present throughout. No one is milling about. Those who are in sight are moving with purpose, never taking time to stop and chat. The only sounds are those of perfectly timed machinery, never failing to miss a beat....

The above is only this author's perception of what the factory of the future might be like. Many have other ideas, and it is the uncertainty which has made this topic a popular one for discussion. Workers have traditionally feared automation and the changes which it brings. Often, human nature perceives anything new as threatening. Blue collar workers especially see robots and microcomputers as invading their work environment and displacing them from their present jobs.

B. Job Loss and the Factory of the Future

With regard to the fear of robots replacing humans in the factory, it has been estimated that the current generation of robots has the potential to displace up to 1.3 million manufacturing workers in the present decade, while the

robots of the 1990s could take over as many as 3 million additional jobs (Ayres & Miller, "Robotic Realities," p. 28). In 1977 there were approximately 1,600 working robots in the United States, while five years later the number increased to 6,800 (Ayres & Miller, "Robotic Realities," p. 50). If these robots, on average, replaced two to three laborers at most, only about 20,000 workers would have been replaced by robots in 1982. This maximum possible displacement would have amounted to only 0.2% of the 9.7 million semi-skilled operators and unskilled manufacturing workers in the United States (Ayres & Miller, "Robotic Realities," p. 50). Therefore, as of the early 1980s, at least, the introduction of robots in U.S. manufacturing firms does not appear to have had a devastating impact on the level of employment.

Although the number of jobs lost to robots to date has been relatively small, the impact of technological change has not been evenly dispersed across the entire workforce. Furthermore, according to Ayres and Miller, future displacement will most likely manifest itself mainly in the following ways:

1. Almost one-half of the displaced workers will come from metalworking industries.
2. Job losses will have a greater impact upon younger workers since seniority will protect older employees from losing their jobs.
3. The North Central region will be the primary geographic target for job loss because this area contains many old, highly unionized factories which pay relatively high wages.
4. Minorities and women will most likely feel the effects of technological change more than other groups.

The switch which has occurred so far from labor intensive methods of production to highly automated processes has already transformed many companies' labor requirements. Increasingly, the need is for fewer but more highly skilled workers. This will present a major problem for the typical factory worker who is not likely to have the necessary educational

background or the skills to meet retraining requirements. Furthermore, technological change will probably affect not just the unskilled worker. Even upper management could also feel the displacement effects of automation.

II. Workers in the Transformation Process

If workers were more adequately prepared for the transformation to the factory of the future, management would find the results more efficient and effective. In fact, worker acceptance of new technology is vital when introducing automation into the workplace (Buss, p. 26). Therefore, many problems may result if management does not assist employees through the transformation. To illustrate this point more clearly, I will next address the following four areas: worker resistance to technological change, retraining and educational programs, the necessity of worker flexibility during the transformation process, and managerial responses to various incidental costs associated with technological change.

A. Worker Resistance to Change

The effect of technological change on employment is not a new issue in America. Throughout our nation's history, we can see examples of mechanization revolutionizing jobs: the tractor displaced the plow, the automobile replaced the horse and buggy, and the automatic pilot eased the duty of airline pilots. Yet, the general American public has not received these innovations in the same way. Some of these changes opened opportunities in new fields while others made the skill of an entire segment of the nation's workforce obsolete.

Because of worker apprehension, management must be prepared to guide and help employees prepare for the transformation to the new automation. It is necessary to emphasize the positive aspects of automation when introducing it to the workforce. The emergence of robotic car painting, for example, has meant that workers are no longer exposed to a work environment which can be hazardous to respiratory health.

Also, worker resistance can negatively affect the productivity and efficiency promised by

new technology. In order to avert this, management must provide clear channels of communication and consultation which allow employees to express their concerns about newly implemented technology. Such two way channels of communication will enable workers to resolve any fears of the workplace and help ensure a smooth transition.

When Ford Motor Company constructed its Dearborn Engine Plant, recognition of potential worker resistance was incorporated into the initial planning. Seven million dollars was allocated for training ("Human Resource Development and New Technology in the Automobile Industry," p. 92). Also, fourteen months prior to the opening of the plant, top management at Ford told plant supervisors and maintenance managers about possible career options at the "new factory." Two months later, management informed the employees of their job positions in the automated factory. By giving ample advance notice to its employees, Ford thus created a situation where sufficient preparation for technological implementation could begin. Although the overall transformation ran smoothly, management still encountered problems. For example, there was some resistance among plant production workers who did not fully understand the changes ("Human Resource Development and New Technology in the Automotive Industry," p. 93). Management used several techniques to combat such problems, with additional training as the primary tool ("Human Resources and New Technology in the Automotive Industry," p. 94).

Worker resistance such as that observed in the above situation is most common whenever firms implement major technological changes without appropriate communication and consultation with the workforce. Therefore, it is imperative for management to explain to the workers the benefits which can occur after the automation. For example, we have already noted that robotics often creates a safer working environment. Furthermore, advanced technology can sometimes provide the unmotivated or bored worker with an opportunity to leave a less challenging position and retrain

for a job offering more responsibility and challenge (Sata, p. 153).

Since many of the existing routine plant jobs are eliminated with the arrival of the new automation, it becomes the responsibility of management to encourage the worker to avail himself of the opportunity to retrain for the new skills or professions within the organization. If this reality is clearly communicated by management and understood by the workforce, the overall effect should be a smoother transformation to automation and an upgrading of worker skills.

Conversely, automation itself can also create jobs that often become routine (Buss, p. 17), as stimulating manual jobs are frequently replaced by tedious automated jobs which can result in workers becoming inattentive and prone to accidents (Bortz, p. 17). Thus, the role of management is challenged to evaluate the skills, interests, and potentials of the worker and provide counseling and retraining to maximize worker satisfaction and productivity.

Another negative consequence of new technology is potential worker displacement. Highly automated factories tend to favor robots over human operators. A good example of this is the unmanned space exploration programs. Humans supervise and control these robots from a remote site (Lyman & Madni, p. 41). Furthermore, the workers' concern for job security may create an environment of apathy. This fear of job loss can change the attitude of the worker to one of passive acceptance rather than active participation in the retraining programs (Buss, p. 20). Thus, again management must foresee the potential negative effects and implement retraining programs to provide the worker with needed new skills either to secure his job or to position himself for another job.

One must remember that automation of a factory does not take place overnight. Often, many years are needed to achieve a high tech operation. This transformation, fortunately, creates a time period during which management can and must plan, communicate, and implement programs which overcome worker resistance through retraining.

B. Need for Retraining

Ayres and Miller have offered a set of guidelines to be followed for a successful transition to robotics:

Private industry, organized labor, government and educational institutions must commit themselves to a cooperative effort to:

- 1) identify vulnerable categories of workers well in advance of actual job elimination,
- 2) plan for future employment needs and new job skill requirements,
- 3) provide effective education and training facilities to upgrade workers from skill categories that are no longer needed to skill categories that are,
- 4) provide effective facilities to locate suitable jobs and place workers in them (Ayres & Miller, "Robotics and Conservation of Human Resources," pp. 181-182).

Although all of the above procedures are essential for a smooth transformation, the third deserves particular attention. The more robots, computers, and other types of automation which the company employs and the greater the sophistication of this equipment, the larger the potential job loss and the greater the need for assisting workers to improve and/or redirect their skills. This, in effect, creates the need for effective retraining. And to be effective, the educational and training facilities must provide programs determined solely by the individual needs of the worker and the requirements of the new job. The approach can be traditional, but the base of the curriculum must be highly specific to worker and company needs. Examples of traditional educational training programs are "on the job" training, classroom instruction, outside seminars or workshops, and government programs.

Although others may have different views, I feel that employers should take an active role in implementing these training programs which will improve or redirect employee skill levels to help the worker meet the new demand of the

factory of the future. By doing this, workers of long standing are more able to maintain employment, and management is able to avoid the costs of hiring new employees.

C. Worker Flexibility to Take on New Responsibilities

While management's cooperation in providing the necessary retraining opportunities is vital, workers must be willing to become more adaptable and willing to accept new and challenging responsibilities. Basically, today's factory floor employees must be willing to make the transformation from manual to mental work (Rose, p. 48). It can generally be assumed that along with the arrival of tomorrow's factory will come jobs requiring higher levels of skill and providing more responsibilities and duties (Ferman, p. 144). As stated earlier, this will result in fewer, but more challenging, positions. For example, a supervisor may progress from a mere "watchdog" figure to a more valuable employee whose function is to communicate, plan, and train (Skinner, p. 105). The initiation of a computer automation system will necessitate that the job descriptions of all employees, from operators to engineers, will change in some way (Sata, p. 159). By conforming to these new demands, many employees can attempt to preserve their job security within the factory instead of being passively replaced by automation (Hymowitz, p. 11). Still, there are many jobs which will be eliminated entirely by the introduction of automation. Unfortunately, these employees will have to look elsewhere for employment and may encounter the problem of being replaced by new technology throughout their search.

Based on researchers' predictions and on past experience, the particular types of jobs most likely to be affected by automation are easily identified. In general, there will be an increase in demand for technicians, mechanical repairmen and installers, engineers, and computer science technicians. Additionally, the factory of the future will require more people in the technical sales and upper management positions. However, there will be an overall decrease in the demand for operators, laborers,

craftsmen, and clerical personnel (Rose, p. 48). Several types of jobs have already been severely affected by robot implementation. Spot welding now utilizes more than 50% of all robots employed in factories in the United States. Materials handling, painting, and assembly tasks are becoming increasingly subject to robotic inroads (Lawson, p. 62).

Recognizing this trend towards automation, management must assist factory workers through appropriate counseling to prepare for tomorrow's technology. In order to allow the transformation to progress smoothly, however, both labor and management must work together in the reorganization of work processes (Kelley, p. 6). To further aid this transformation, management must successfully promote technology's benefits to the employees (Sata, p. 159). Therefore, the planning stage of technology implementation is of extreme importance if worker flexibility is to be realized. It may not be an exaggeration to say that as much effort should go into the planning for the transition period as to the implementation itself.

D. Incidental Costs

Now that I have discussed workers' resistance to change, the need for retraining, and the need for worker flexibility, I will focus on some incidental costs—not all of them pecuniary and some of them unanticipated—which can be associated with technological implementation. When management begins to convert to an automated factory, the more the organization tries to plan for these incidental costs, the better equipped it will be to deal with and solve these problems.

Total planning is the primary concern in the adoption of the physical plant itself. However, although structural changes and their accompanying costs are readily identifiable, many of the costs associated with production and quality control are frequently not considered. Significant costs can be incurred through downtime in production, loss of quality control, and repair costs. Also, the need for modernized programming of the computer system can add to the list of costs. Often, solutions to these problems are very expensive and are not always permanent (Kelley, p. 6).

Another type of incidental cost associated with technological change is the "human cost." Workers who lose their jobs because of new technology represent a direct cost to the community and an indirect cost to the company. The direct cost to the community is in jobs lost. However, the indirect cost to business is in loss of corporate image, for businesses who have mass layoffs are often perceived as poor corporate citizens.

Computer related stress presents still another cost. It may not be entirely correct to label it a pecuniary cost, and it is one which is not easily measurable at this time. However, computer operators are winning more and more disability suits because of computer-related stress. Workers are making claims for maladies ranging from eye strain to muscular pains. All this, in turn, is certain to result in higher insurance payments for the companies (Trost, p. 34).

It is important for management to combine its resources and try to reduce the incidence of these costs. Currently, however, there seems to be a certain hesitancy among competing firms to discuss how to properly plan for the implementation of new technology (Kelley, p. 22). As these firms encounter many of the same unanticipated costs, many problems could be alleviated by sharing information about successful solutions. Still another suitable strategy would be to seek the advice of the workers themselves for ideas about planning for the implementation of new technology. After all, it is the workers who often have the clearest picture of everyday problems, both in the mechanical and the human resource areas (Kelley, p. 22).

III. Conclusion

The factory of the future is a major evolution which society may have to accept as a necessity in order to survive foreign competition. Robots are here to stay. Some firms have encountered difficulty in the automation process because of the human resource aspects, but workers play a key role in the transformation to automation. Therefore, by addressing the problem of worker resistance, implementing retraining programs, increasing worker flexibility and

responsibility, and curbing unanticipated costs, the transition from the factory of the present to

the factory of the future will be easier, more efficient, and more effective.

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